MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

EME2036 - MANUFACTURING AND OPERATIONS MANAGEMENT

(ME/RE)

8 AUGUST 2022
9:00 a.m - 11:00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of **9** pages including cover page and appendix with **4** Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

Question 1

(a) Actual demand over the last 8 months for a most popular Nasi Lemak in Melaka sale is shown in the **Table Q1(a)** below:

i) Compute the 3-month simple moving average forecast for March.

[5 marks]

ii) Compute the 3-period weighted moving average with the weights (0.5,0.3,0.2)

[5 marks]

iii) Compute the exponential smoothing forecast for March assuming an initial forecast of 100? Alpha = 0.4

[5 marks]

Table Q1(a)

Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Forecast	100	110	125	130	145	160	160	150
Orders	96	110	106	115	127	105	100	125

(b) A new hypermarket has determined the "demand points" and their relative locations in Batu Berendam as given in the **Table Q1(b)** below:

Table Q1(b)

Demand Points	***X*- Coordinate (km)**	***Y*- Coordinate (km)**	**Load (tons)**
A	12	15	1000
B	22	9	450
C	16	14	750
D	14	15	550
E	8	12	650
F	4	16	600

i) If a company desires to locate a warehouse facility at the center of gravity, would be the x and y coordinates of the facility?

[5 marks]

ii) Using rectilinear distance, what is the resulting load–distance score for this location?

[5 marks]

Continued ...

Question 2

(a) The Jerry Choo Shoe specializes in repairing branded lady shoes. Currently, five types of shoes with varying problems are awaiting service. The best estimates for the labour times involved and the promise dates (in number of days from today) are shown in the following **Table Q2(a)**. Customers usually do not pick up their shoes early.

Table Q2(a)

Shoe	Estimated Labor Time (days)	Promise Date (days from now)
Ankle Strap Heels	5	8
Wedge Heels	4	15
Stilettoes	10	12
Mules	1	20
Pumps	3	10

Develop separate schedules using SPT and then EDD rules. Compare them using average job flow time, % of past due jobs, and maximum past due days. Calculate average WIP inventory (in engines) and average total inventory.

[10 marks]

(b) A Global Venture Pt. Ltd operates 52 weeks per year, and its cost of goods last year was RM6,500,000. This company carries eight item in inventory, four raw materials, two work-in-progress items, and two finished goods (see **Table Q2(b)** that represents last year data as detailed).

Table Q2(b)

	Part Number	Average Inventory units	Value/unit
Raw Materials	RM-1	20,000	RM1
	RM-2	5,000	5
	RM-3	3,000	6
	RM-4	1,000	8
WIP	WIP-1	6,000	10
	WIP-2	8,000	12
Finished goods	FG-1	1,000	65
	FG-2	500	88

i) What is the average aggregate inventory value?

[9 marks]

ii) How many weeks of supply does the firm have?

[4 marks]

iii) What was the inventory turnover last year?

[2 marks]

Continued...

Question 3

(a) Data related to an assembly line installation project is given in **Table Q3(a)**. The indirect costs involved in the installation amount to RM 250 per day. The contractor will incur a RM100 per day penalty for each day the project lasts beyond day 140.

Table Q3(a) Project data

Activity	Normal Time (days)	Normal Cost (RM)	Crash Time (days)	Crash Cost (RM)	Immediate Predecessors (s)
A	50	10,000	40	12,000	-
B	50	8,000	30	20,000	-
C	20	6,000	10	9,000	A, B
D	30	15,000	20	20,000	B
E	50	9,000	30	12,000	C, D
F	20	13,000	10	15,000	E
G	30	9,000	30	9,000	E
H	50	5,000	30	9,000	G

i) Draw the network diagram and estimate the project's duration.

[5 marks]

ii) Find the new critical path and total project cost for crashing activity E to 30 days from 50 days.

[5 marks]

iii) Finally, crash the activity H to 30 days from 50 days and find the new critical path and total project cost.

[5 marks]

Continued ...

(b) Computer upgrades have a nominal time of 80 minutes. Samples of five observations each have been taken, and the results are as listed in **Table Q3(b)**. Assume factors for calculating limits for $\bar{x}$ and R- chart for the sample size of 5 is, A_2=0.58, D_3=0.00, D_4=2.11.

Table Q3(b) Observed data

Sample Number	Observations				
	1	2	3	4	5
1	79.2	78.8	80.0	78.4	81.0
2	80.5	78.7	81.0	80.4	80.1
3	79.6	79.6	80.4	80.3	80.8
4	78.9	79.4	79.7	79.4	80.6
5	80.5	79.6	80.4	80.8	78.8
6	79.7	80.6	80.5	80.0	81.1

i) Calculate the process average and range.

[4 marks]

ii) Determine upper and lower control limits for mean and range charts, and decide if the process is in statistical control.

[6 marks]

Continued ...

Question 4

(a) Tesla Motor service center servicing the vehicle of customers on a first-come first-served basis. The service center has four working bays, each bay worked by a technician. Customer's vehicles arrive at the rate of six per hour, according to a Poisson distribution, and do not balk or renege. The average time of maintenance service required for a technician is 30 minutes, according to an exponential distribution.

i) What is the probability that zero cars in the service center?

[5 marks]

ii) Determine the average number of cars waiting in the service center.

[5 marks]

(b) The master production schedule start quantities for product A, calls for 60 units in week 2, 70 units in week 5 and 85 units in week 8. Item C is produced to make product A and to meet the forecasted demand for replacement parts. Past replacement demand has been 20 units per week (add to C's gross requirements). The lead times for item C is 1 week, and for the other items B and D the lead time is 2 weeks. No safety stocks is required for items B, C, and D. The L4L lot-size is used for items B; the POQ lot-sizing rule (p=3) is used for C. Items D has an FOQ of 250 units. On-hand inventories are 50 units of B, 50 units of C, 125 units of D. Item B has scheduled receipt of 70 units in week 2. Develop a material requirements plan for the next 8 weeks for items C and D. The bill of material for product A is shown in **Figure Q4(b)**.

[15 marks]

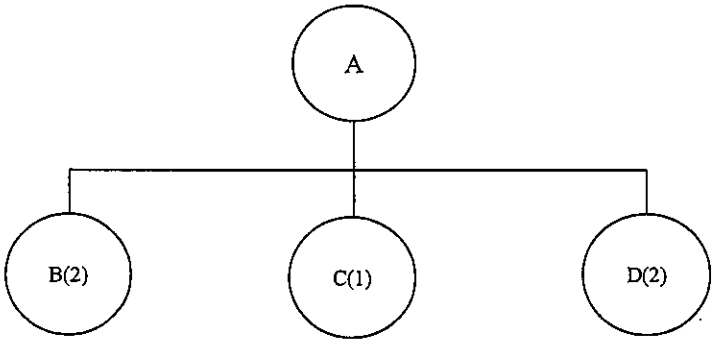

Figure Q4(b)

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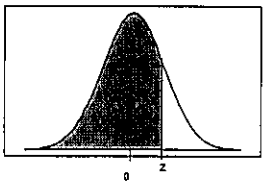
Appendix 1 Standard Normal Cumulative Probability Table



Cumulative probabilities for POSITIVE z-values are in the following table:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990

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Appendix 2 Factors for calculating three-sigma limits for the x-chart and R-chart

Size of Sample (n)	Factor for UCL and LCL for x-Chart (A_2)	Factor for LCL for R-Chart (D_3)	Factor for UCL for R-Chart (D_4)
2	1.880	0	3.267
3	1.023	0	2.575
4	0.729	0	2.282
5	0.577	0	2.115
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

Process capability:

$$C_{pk} = Minimum\ of \left[\frac{\bar{\bar{x}} - Lower\ specification}{3\sigma}; \frac{Upper\ specification - \bar{\bar{x}}}{3\sigma}\right]$$

$$C_p = \left[\frac{Upper\ specification - Lower\ specificaation}{6\sigma}\right]$$

Inventory Management

$$\text{EOQ} = \sqrt{\frac{2DS}{H}}$$

$$\text{Time between Order} = \frac{Q}{D}$$

$$\text{Number of order per year} = \frac{D}{Q}$$

$$\text{Total annual cost} = \left(\frac{Q}{2}\right)H + \left(\frac{D}{Q}\right)S$$

Supply Chain Management

$$\text{Week of supply} = \frac{Average\ aggregate\ inventory\ value}{Weekly\ sales\ (at\ cost)}$$

$$\text{Inventory turnover} = \frac{Weekly\ sales\ (at\ cost)}{Average\ aggregate\ inventory\ value}$$

Total Annual cost = pD + Freight costs + $(Q/2 + dL)H$ + Administrative costs

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Waiting Line Models Equations:

$$\rho = \frac{\lambda}{\mu} \qquad \rho = \frac{\lambda}{s\mu} \qquad \rho = 1 - P_0$$

$$P_n = (1-\rho)\rho^n \qquad P_n = \begin{cases} \dfrac{(\lambda/\mu)^n}{n!} P_0 & 0 < n < s \\ \dfrac{(\lambda/\mu)^n}{s!\, s^{n-s}} P_0 & n \geq s \end{cases}$$

$$P_0 = 1 - \rho \qquad P_0 = \left[\sum_{n=0}^{s-1} \frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^s}{s!} \left(\frac{1}{1-\rho} \right) \right]^{-1} \qquad P_0 = \left[\sum_{n=0}^{N} \frac{N!}{(N-n)!} \left(\frac{\lambda}{\mu} \right)^n \right]^{-1}$$

$$L = \frac{\lambda}{\mu - \lambda} \qquad L = \lambda W \qquad L = N - \frac{\mu}{\lambda}(1 - P_0)$$

$$L_q = \rho L \qquad L_q = \frac{P_0 (\lambda/\mu)^s \rho}{s!(1-\rho)^2} \qquad L_q = N - \frac{\lambda + \mu}{\lambda}(1 - P_0)$$

$$W = \frac{1}{\mu - \lambda} \qquad W = W_q + \frac{1}{\mu} \qquad W = L[(N-L)\lambda]^{-1}$$

$$W_q = \rho W \qquad W_q = \frac{L_q}{\lambda} \qquad W_q = L_q[(N-L)\lambda]^{-1}$$

End of paper